

subjecting said wiring material film to a chemical mechanical polishing to remove said wiring material film excluding a wiring material film portion which is buried in said wiring groove, said chemical mechanical polishing taking place, with the conductive barrier film on said insulating film being employed as a stopper, except for a conductive barrier film portion located inside said wiring groove; and

subjecting a conductive barrier film portion which is located on said insulating film excluding said wiring groove to a chemical mechanical polishing by making use of a slurry for chemical mechanical polishing, which contains polishing particles comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter ranging from 20 nm to 50 nm, wherein the weight ratio of the first colloidal silica particles is in the range of 0.6 to 0.9 based on a total weight of said first and second colloidal silica particles.

REMARKS

In this Amendment after Final, Applicants propose amending claims 18 and 23 to more appropriately define the present invention. In accordance with the requirements of 37 C.F.R. § 1.121(c)(1), Applicants provide a marked-up version of the amendments made to the claims in the attached appendix designated “Version of Claims with Markings to Show Changes Made.” Applicants submit that the amendments contain no new matter, in accordance with the requirements of 37 C.F.R. § 1.121(f).

Regarding the Office Action:

Claims 1 – 37 remain pending, with claims 1 – 17 withdrawn from consideration as drawn to a nonelected invention, and claims 18 – 37 under current examination. In the Final

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Office Action, the Examiner rejected claim 30 under 35 U.S.C. § 112, second paragraph; rejected claims 18 – 21, 23 – 27, 30, 32, and 33 under 35 U.S.C. § 103(a) as unpatentable over Wojtczak, et al. (U.S. Patent No. 6,409,781) in view of Hudson (U.S. Patent No. 6,407,000); rejected claims 22, 28, 31, 34, 36, and 37 under 35 U.S.C. § 103(a) as unpatentable over Wojtczak in view of Hudson as applied to claims 18 – 21 and 23 – 25, and further in view of Bruxvoort, et al. (U.S. Patent No. 5,958,794); and objected to claims 29 and 35 as dependent upon a rejected base claim, but indicated these claims would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Applicants appreciate the Examiner's thorough examination of this application and the indication that claims 29 and 35 are drawn to allowable subject matter, though respectfully traverse the objections and rejections, as detailed above, for the following reasons.

Regarding the Claim Amendments:

Applicants amend claims 18 and 23 to more appropriately define the invention. Specifically, Applicants have amended claims 18 and 23 to specify a range of diameters for the second colloidal silica particles: “second colloidal silica particles whose primary particles have a diameter [larger than] ranging from 20 nm to 50 nm.” Support for this amendment may be found, among other places, in the specification on page 15, lines 6 – 8, which discloses that “the diameter of the primary particles of the second colloidal particles should be preferably be larger than 20 nm but not larger than 50 nm.”

Applicants submit that these amendments contain no new matter, in accordance with the requirements of 37 C.F.R. § 1.121(f). Applicants respectfully remind the Examiner that “[a]mendments to an application which are supported in the original description are NOT new matter.” M.P.E.P. § 2163.07, emphasis in original.

Thus, Applicants submit that these amendments should render the application in condition for allowance after consideration of the remarks that follow, and should not place any burden on the Examiner insofar as raising new issues or requiring further searches of the art for him to reconsider these claims, as amended.

Regarding the Rejection of Claim 30 under 35 U.S.C. § 112, 2nd ¶:

Regarding the rejection of claim 30 under 35 U.S.C. § 112, 2nd paragraph, the Examiner indicated that claim 30 should be clarified “whether “colloidal silica particles” refers to “first colloidal silica particles” or “second colloidal silica particles.”” (Final Office Action, p. 2). Applicants respectfully point out to the Examiner, however, that it would not be proper to modify “colloidal silica particles” to “first” or “second” colloidal silica particles in claim 30, for the following reasons.

First, the “slurry” recited in claim 30 finds support in the specification, among other places, on p. 9, lines 10 – 16, and p. 28, lines 9 – 19. These portions of the specification describe that CMP processing of the claimed “conductive barrier film” is performed by using the slurry for CMP mentioned on p. 9, lines 10 – 16.

Second, the CMP slurry just described comprises colloidal silica particles, but does not use different types of colloidal silica particles (such as “first” and “second” colloidal silica particles). Further, the claimed “colloidal silica particles” of claim 30 are different in composition from the claimed “first” and “second colloidal silica particles” of amended claim 18. Therefore, it is not possible to amend claim 30’s “colloidal silica particles” to “first” or “second colloidal silica particles” as in amended claim 18. Doing so would run contrary to the support in the specification, indicated above. Therefore, the claimed subject matter is not indefinite.

Applicants therefore deem the rejection of claim 30 overcome. The pending claims fully comply with the requirements of 35 U.S.C. § 112, 2nd paragraph, and Applicants accordingly request withdrawal of the rejection.

Regarding the Rejection of Claims 18 – 21, 23 – 27, 30, 32, and 33 under 35 U.S.C.

§ 103(a):

Applicants respectfully traverse the rejection of claims 18 – 21, 23 – 27, 30, 32, and 33 under 35 U.S.C. § 103(a) as unpatentable over Wojtczak in view of Hudson. Applicants respectfully disagree with the Examiner's arguments and conclusions, and respectfully submit that a *prima facie* case of obviousness has not been established.

In order to establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim elements. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. Third, there must be a reasonable expectation of success. *See* M.P.E.P. § 2143.

The Examiner does not show that all the elements of Applicants' claims are met in the cited references, does not show that there is any suggestion or motivation to modify the cited references to result in the claimed invention, and does not show there would be any reasonable expectation of success from so doing.

Prior Art Reference(s) Must Teach or Suggest All the Claim Elements

To begin, Applicants respectfully point out to the Examiner that it "is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position, to the exclusion of other parts necessary to the full

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appreciation of what such reference fairly suggests to one of ordinary skill in the art.” *See In re Wesslau*, 147 U.S.P.Q. 391 (C.C.P.A. 1965), emphasis added. *See also* M.P.E.P. § 2141.02. Applicants dispute the Examiner’s contention that those references teach or suggest each and every element of Applicants’ claimed invention. Applicants submit that, for the reasons detailed below, the Examiner is only using so much of the cited references to support his position, to the exclusion of other parts necessary to give a full appreciation of what the references fairly suggest to one of ordinary skill in the art.

Wojtczak, taken alone or in combination with Hudson, does not teach or suggest at least the elements of Applicants’ independent claims 18 and 23. In contrast to the present invention, Wojtczak utilizes *two* slurries applied in succession, not Applicants’ claimed “*a* slurry” “comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter ranging from 20 nm to 50 nm.” *See* Wojtczak, Abstract, col. 2, ll. 28 – 35 (“two-step slurry approach”), col. 2, ll. 60 – 62 (“a first slurry … and a second slurry”), col. 3, ll. 60 – 64 (“The first slurry” and “The second slurry”), col. 4, ll. 24 – 30 (“providing a first [CMP] slurry that has a high removal rate on copper 14 and a low removal rate on barrier metal 13” and “providing a second [CMP] slurry that has a high removal rate on barrier metal 13 … and a low removal rate on the dielectric material”), and col. 9, ll. 55 – 65 (Wojtczak’s claim 1).

While the Examiner admitted some of Wojtczak’s deficiencies, such as,

“Wojtczak et al. do not teach subjecting said conductive material film 13 and 14 to a chemical mechanical polishing (CMP) using a slurry comprising *first* colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm and *second* colloidal silica particles whose primary particles have a diameter *larger than 20nm*, wherein the weight ratio of the first colloidal silica

particles is in the range of *0.6 to 0.9* based on a total weight of said first and second colloidal silica particles" (Final Office Action, pp. 3 – 4), the application of Hudson in combination with Wojtczak still does not cure Wojtczak's deficiencies. Hudson, while utilizing a bimodal particle approach (*See* Hudson, Abstract), still does not teach or suggest at least the elements of Applicants' independent claims 18 and 23 when taken alone or in combination with Wojtczak. Hudson also differs from Applicants' claimed invention, in part because Hudson's second abrasive particles included in the bimodal slurry have a *diameter ranging from 70 to 400 nm*. *See* Hudson, col. 6, line 5 ("approximately 0.070-0.40 μm "). This contrasts with Applicants' claimed invention, wherein claims 18 and 23 recite, in part, "second colloidal silica particles whose primary particles have a *diameter ranging from 20 nm to 50 nm*" (claims 18 and 23, italics added).

Applicants therefore submit that Wojtczak and Hudson, taken individually or in combination, do not teach or suggest at least Applicants' claimed "a slurry for chemical mechanical polishing, which contains polishing particles comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter ranging from 20 nm to 50 nm" (claims 18 and 23).

Thus, contrary to the Examiner's allegation, it would NOT "have been obvious .. to substitute the two-step CMP with mono-modal slurry as taught by Wojtczak et al. with the bi-modal slurry of Hudson" (Final Office Action, page 4). Even if Hudson's slurry was employed in Wojtczak's two-step CMP process, this still would not produce Applicants' claimed invention.

This conclusively demonstrates just some of the differences between Wojtczak, Hudson, and Applicants' present claimed invention. The Examiner has therefore not met at least one of

the essential criteria for establishing a *prima facie* case of obviousness, wherein “the prior art reference (or references when combined) must teach or suggest all the claim limitations.” *See* M.P.E.P. §§ 2142, 2143, and 2143.03.

Suggestion or Motivation to Modify or Combine Reference Teachings

The M.P.E.P. sets forth:

“However, “The mere fact that a worker in the art could rearrange the parts of the reference device to meet the terms of the claims on appeal is not by itself sufficient to support a finding of obviousness. *The prior art must provide a motivation or reason for the worker in the art, without the benefit of appellant’s specification, to make the necessary changes in the reference device.*” *Ex parte Chicago Rawhide Mfg. Co.*, 223 USPQ 351, 353 (Bd. Pat. App. & Inter. 1984).” M.P.E.P. § 2144.04, italics added.

As such, the present invention, as recited in independent claims 18 and 23, cannot be attained based merely on Wojtczak, or on a combination of Wojtczak and Hudson. One skilled in the art would only arrive at the present claimed invention by consulting Applicants’ disclosure. Therefore, the only way to construct the claimed invention from the cited references would be to rely on aspects related to the present invention. Such reliance, however, would constitute improper hindsight reasoning. Wojtczak’s utilization of two slurries applied in succession does not lend itself to combination with Hudson’s bimodal slurry approach. This is because Wojtczak aims to improve CMP by minimizing dishing in Cu interconnects. Wojtczak’s two step slurry approach is designed to first remove Cu with a high removal rate and low barrier material removal rate, followed by a second slurry with a high barrier removal rate and Cu removal rate, with a low removal rate for the dielectric material. *See* Wojtczak, col. 2, lines 28 – 38. Hudson, on the other hand, aims to improve stability of particles in the CMP solution by

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either utilizing a bimodal slurry or a mono-modal slurry to rapidly planarize a surface. Hudson does not even address the problems of dishing or selective removal rates for interconnect, barrier, or dielectric materials that are raised by Wojtczak. See Hudson, col. 3, lines 25 – 40 and lines 45 – 57. Applicants submit that these references, while all trying to improve CMP, actually diverge from each other in aim and scope, and therefore also teach away from the present invention, for the reasons already presented.

First, Applicants have already demonstrated that a worker in the art cannot rearrange parts of Wojtczak and/or Hudson to produce Applicants' claimed invention. Second, Applicants have also demonstrated that the cited references teach away from the present invention, and therefore they cannot provide any motivation or reason for one of ordinary skill in the art to modify the references, or combine them, to produce the present claimed invention. Third, Applicants note that one of ordinary skill in the art must have this motivation or reason *without the benefit of Applicants' specification* to modify the references.

As already demonstrated, such combination of these references *a priori* fails to establish obviousness of the claimed invention. Furthermore, Applicants have pointed out deficiencies in the cited prior art that render nugatory any indication that the cited references would give motivation or reason to one of ordinary skill in the art to modify them *without the benefits of Applicants' specification*.

Therefore, Applicants submit that Wojtczak, taken alone or in combination with Hudson, does not suggest the desirability of any modification to result in Applicants' claimed invention.

Reasonable Expectation of Success Required for Prima Facie Obviousness

In addition, regarding the required reasonable expectation of success, as evidenced from previously arguments regarding Wojtczak and Hudson's disclosures, Applicants submit that

there would be no reasonable expectation of success to be derived from modifying Wojtczak and/or Hudson, as this would diverge from Applicants' claimed

"a slurry for chemical mechanical polishing, which contains polishing particles comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter ranging from 20 nm to 50 nm, wherein the weight ratio of the first colloidal silica particles is in the range of 0.6 to 0.9 based on a total weight of said first and second colloidal silica particles" (claims 18 and 23).

This also demonstrates that the Examiner's reliance on Wojtczak and Hudson is not sufficient to establish *prima facie* obviousness.

Since Applicants have already demonstrated: (1) deficiencies in the cited references, (2) that they are not combinable to produce the present claimed invention, (3) that they teach away from the present invention, and (4) that they do not provide any suggestion or motivation to produce the present claimed invention, it logically flows that there would be no reasonable expectation of success expected by one of ordinary skill in the art when combining Wojtczak and Hudson.

In summary, the Examiner has not met any of the essential criteria for establishing a *prima facie* case of obviousness. Applicants have demonstrated above that the Examiner: (a) has not shown all elements of Applicants' claimed invention are taught or suggested by Wojtczak and Hudson; (b) has not shown any requisite suggestion or motivation to modify Wojtczak and Hudson to produce Applicants' claimed invention; and (c) has not shown there would be any reasonable expectation of success from modifying Wojtczak and Hudson in order to produce the

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present claimed invention. Thus, Applicants submit that the Examiner's reliance on these references fails to establish *prima facie* obviousness.

Finally, Applicants note that the M.P.E.P. sets forth that “[i]f an independent claim is nonobvious under 35 U.S.C. § 103, then any claim depending therefrom is nonobvious.” M.P.E.P. § 2143.03.

Therefore, Applicants submit that independent claims 18 and 23 are allowable, for the reasons argued above. In addition, dependent claims 19 – 22 and 24 – 37 are also allowable at least by virtue of their respective dependencies from allowable base claims 18 and 23. Therefore, Applicants respectfully submit that the Examiner should withdraw the 35 U.S.C. § 103(a) rejection.

Regarding the Rejection of Claims 22, 28, 31, 34, 36, and 37 under 35 U.S.C. § 103(a):

Applicants respectfully traverse the rejection of claims 22, 28, 31, 34, 36, and 37 under 35 U.S.C. § 103(a) as unpatentable over Wojtczak in view of Hudson as applied to claims 18 – 21 and 23 – 25, and further in view of Bruxvoort. Applicants respectfully disagree with the Examiner's arguments and conclusions, and submit that a *prima facie* case of obviousness has not been established.

The requirements for establishing a *prima facie* case of obviousness have been set forth previously. Wojtczak, Hudson, and Bruxvoort, taken alone or in combination, do not teach or suggest at least the elements of Applicants' claims 22, 28, 31, 34, 36, and 37.

By the arguments provided in the previous section, Applicants have demonstrated the patentability of Applicants' independent claims 18 and 23 over Wojtczak and Hudson. The addition of Bruxvoort, alleged by the Examiner as being “in an analogous art of CMP [to] teach

utilizing a slurry containing a mixture of two or more different types of abrasive particles (col. 20, lines 3-9) for the purpose of improving planarity and uniformity (col. 2, lines 12-22); and the third particles can be colloidal alumina particles for altering the [erodibility] of the abrasive particle (col. 21, lines 27-38 and lines 51-63)" (Final Office Action, p. 6), does not cure the deficiencies of Wojtczak and Hudson, in that Bruxvoort still does not address the features of Applicants' present invention not taught or suggested by Wojtczak and Hudson. Bruxvoort instead focuses on a CMP slurry, wherein "preferably, the liquid medium contains less than 1% by weight, preferably less than 0.1% by weight and more preferably 0% by weight inorganic particulates" (Bruxvoort, col. 13, lines 48 – 51), which does not even remotely cure the deficiencies of Wojtczak and Hudson. Bruxvoort does not teach or suggest anything related to at least the above-quoted elements of Applicants' claims 18 and 23, and also, by virtue of the above-quoted portion of Bruxvoort, also teaches away from the present invention.

Applicants therefore submit that dependent claims 22, 28, 31, 34, 36, and 37 are also allowable at least by virtue of their respective dependencies from allowable base claims 18 and 23, since Wojtczak, Hudson, and Bruxvoort, taken alone or in combination, do not teach or suggest each and every element of Applicants' claims 18 and 23. Therefore, Applicants respectfully submit that the Examiner should withdraw the 35 U.S.C. § 103(a) rejection.

Conclusion:

In making various references to the specification and drawings set forth herein, it is understood that Applicants are in no way intending to limit the scope of the claims to the exemplary embodiments described in the specification and illustrated in the drawings. Rather, Applicants expressly affirm that they are entitled to have the claims interpreted broadly, to the maximum extent permitted by statute, regulation, and applicable case law.

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In view of the foregoing, Applicants request reconsideration of the application and submit that the rejections detailed above should be withdrawn. Applicants respectfully request that this Amendment after Final be considered by the Examiner, since it places the present application in condition for allowance. This Amendment after Final should allow for immediate and favorable action by the Examiner. Applicants submit that pending claims 18 – 37 are in condition for allowance, and request a favorable action.

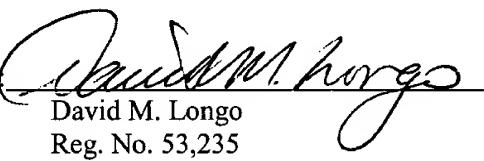
Should the Examiner continue to dispute the patentability of the claims after consideration of this Amendment after Final, Applicants encourage the Examiner to contact Applicants' undersigned representative by telephone to discuss any remaining issues or to resolve any misunderstandings. Applicants' undersigned representative would welcome the opportunity to discuss the merits of the present invention with the Examiner if telephone communication will aid in advancing prosecution of the present application.

Please grant any extensions of time under 37 C.F.R. § 1.136 required in entering this response. If there are any fees due under 37 C.F.R. § 1.16 or 1.17 including any fees required for an extension of time under 37 C.F.R. § 1.136, please charge such fees to our deposit account 06-0916.

Respectfully submitted,

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By


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APPENDIX TO AMENDMENT of July 24, 2003
Version of Specification with Markings to Show Changes Made

AMENDMENTS TO THE CLAIMS:

Please amend claims 18 and 23, as follows:

18. (Twice Amended) A method of manufacturing a semiconductor device, which comprises:

forming a wiring groove on a surface of an insulating film formed above a semiconductor substrate;

depositing a conductive material film on a surface of said insulating film including an inner surface of said wiring groove; and

subjecting said conductive material film to a chemical mechanical polishing by making use of a slurry for chemical mechanical polishing, which contains polishing particles comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter [larger than] ranging from 20 nm to 50 nm, wherein the weight ratio of the first colloidal silica particles is in the range of 0.6 to 0.9 based on a total weight of said first and second colloidal silica particles to remove said conductive material film excluding a conductive material film portion which is buried in said wiring groove.

23. (Twice Amended) A method of manufacturing a semiconductor device, which comprises:

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forming a wiring groove on a surface of an insulating film formed above a semiconductor substrate;

depositing a conductive barrier film on a surface of said insulating film including an inner surface of said wiring groove;

depositing a wiring material film on said conductive barrier film to fill said wiring groove with said wiring material film;

subjecting said wiring material film to a chemical mechanical polishing to remove said wiring material film excluding a wiring material film portion which is buried in said wiring groove, said chemical mechanical polishing taking place, with the conductive barrier film on said insulating film being employed as a stopper, except for a conductive barrier film portion located inside said wiring groove; and

subjecting a conductive barrier film portion which is located on said insulating film excluding said wiring groove to a chemical mechanical polishing by making use of a slurry for chemical mechanical polishing, which contains polishing particles comprising first colloidal silica particles whose primary particles have a diameter ranging from 5 to 20 nm, and second colloidal silica particles whose primary particles have a diameter [larger than] ranging from 20 nm to 50 nm, wherein the weight ratio of the first colloidal silica particles is in the range of 0.6 to 0.9 based on a total weight of said first and second colloidal silica particles.

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